

DOCUMENTED CHROMOSOME NUMBERS
1995:1. CHROMOSOME NUMBER OF *CORNUS*
SESSILIS (CORNACEAE): PHYLOGENETIC
AFFINITY AND EVOLUTION OF CHROMOSOME
NUMBERS IN *CORNUS*

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ABSTRACT

The chromosome number of the Californian cornelian cherry, *Cornus sessilis* Torr., is determined to be $2n=20$, differing from the number ($2n=18$) reported for other cornelian cherries. This is the first report of a chromosome number for *C. sessilis*. The finding of $2n=20$ in *C. sessilis* along with evidence from morphology and molecular data helps clarify the evolutionary trend of chromosome numbers in *Cornus* and suggests an early divergence between the species and its close relatives, *C. mas* - *C. officinalis* - *C. chinensis*.

RESUMEN

El determina el número cromosómico del corncjo de California *Cornus sessilis* Torr. Como $2n=20$, que difiere del número ($2n=18$) citado de otros cornejos. Este es el primer recuento cromosómico de *C. sessilis*. El hallazgo de $2n=20$ en *C. sessilis* junto con la evidencia de datos morfológicos y moleculares ayuda a clarifica las tendencias evolutivas de los números cromosómicos en *Cornus* y sugiere una divergencia temprana entre esta especie y sus parientes más próximos, *C. mas* - *C. officinalis* - *C. chinensis*.

The cornelian cherries, *Cornus* subgen. *Cornus* L. consist of five geographically isolated, red-fruited species (*C. mas* L. in Europe; *C. officinalis* Seib. et Zucc. in eastern China and Japan; *C. chinensis* Wangerin in southwestern China; *C. sessilis* Torr. in California; and *C. volkensii* Harms in Africa). Chromosome numbers of $2n=18$ have been reported for *C. mas* and *C. officinalis* (Dermen 1932). This paper is the first report of a chromosome number for the Californian species *C. sessilis*, and discusses the phylogenetic affinity of the species and the evolutionary trend of chromosome numbers in *Cornus*.

METHODS AND RESULTS

Root-tips from germinating seeds of *Cornus sessilis* were pretreated with saturated *p*-dichlorobenzene for three hours before fixation in a solution of

¹Deseased May, 1990.

3:1 ethanol:glacial acetic acid. Seeds were collected in the field (voucher: Eyde 134 (US), northern California, May 1989) and germinated in the greenhouse. Chromosome counts were made from 15 mitotic cells of root-tip material using standard squash procedures. All cells were determined to be $2n=20$ (Fig. 1).

DISCUSSION

The distribution pattern of the cornelian cherries suggests an old age for the group. The geographic isolation of the various cornelian species parallels the morphological diversity found in the group. For example, the Chinese cornelian cherry, *Cornus chinensis*, is distinct in the genus in having monopodial axes (i.e., terminal leaf buds and axillary flower buds; Xiang 1987) whereas all other species of *Cornus* have sympodial axes (terminal flower buds and axillary leaf buds). The African cornelian cherry, *C. volkensii*, is unique in the genus in being dioecious, and the Californian cornelian cherry, *C. sessilis*, is distinct from other cornelian cherries in its winter bud morphology. A winter bud of the cornelian cherries (except *C. chinensis*) consists of three buds, two lateral leaf buds each with a scale at its outer side, and one terminal inflorescence bud covered by four bracts. The leaf-bud scales in *C. sessilis* are modified and expand to cover completely the inflorescence bud to form the outer-most layer of protective sheaths for the inflorescence bud. In contrast, the leaf-bud scales in other cornelian cherries are small and not modified. Also, the peduncles of the preformed inflorescence of *C. sessilis* are not precocious as they are in other cornelian cherries (Murrell 1993). As a result of the morphological diversity, the taxonomy of the cornelian cherries has been controversial. *Cornus chinensis* and *C. volkensii* have at times been separated from other cornelian cherries (*C. mas*, *C. officinalis*, and *C. sessilis*) and have been recognized as distinct subgroups within *Cornus* or as a distinct genus, such as, *Cornus* subgen. *Sinocornus* for *C. chinensis* (Xiang 1987), and *Afrocrania* or *Cornus* subgen. *Afrocrania* for *C. volkensii* (Ferguson 1966a; Hutchinson 1942; Murrell 1993; Xiang 1987).

Phylogenetic relationships within the cornelian cherries have been proposed by Eyde (1988). Based on morphological and fossil analyses, Eyde (1988) placed *Cornus sessilis* as the sister of a clade that consists of *C. officinalis*, *C. mas*, and *C. chinensis* with the first two as sisters. Eyde considered *C. sessilis* a line that diverged second in the cornelian cherry group, following the divergence between *C. volkensii* and the remaining cornelian cherries. This hypothesis is supported by molecular data. The result of a recent chloroplast DNA (cpDNA) restriction site analysis of *Cornus* by Xiang et al. (in press) revealed that *C. sessilis* is sister to *C. mas* - *C. officinalis* (*C. chinensis* and *C. volkensii* were not included in the cpDNA restriction site study).

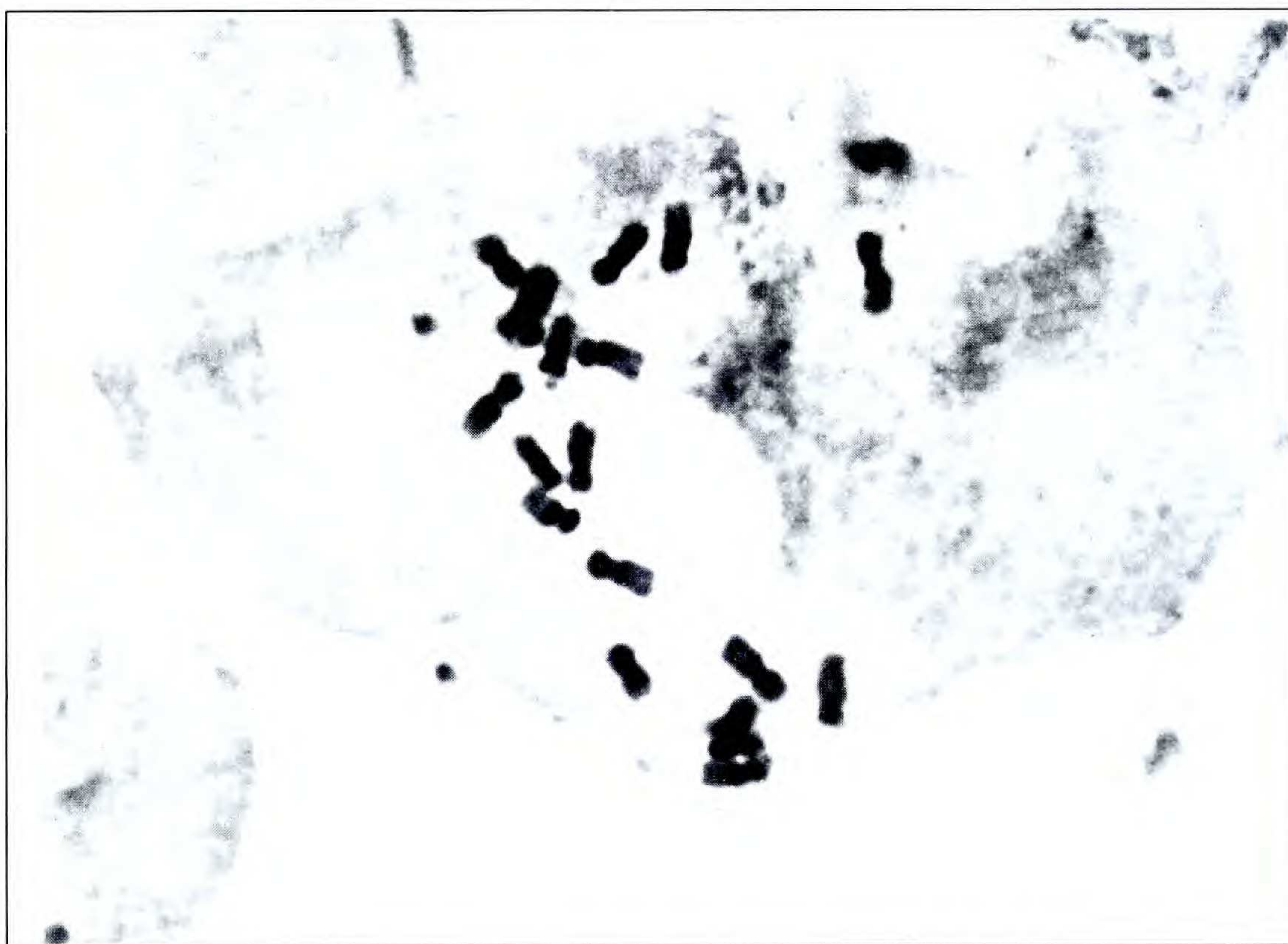


FIG. 1. Mitotic chromosomes of root-tip cells from germinating seeds of *Cornus sessilis* Torr. ($2n=20$, Metaphase).

Furthermore, a phylogenetic analysis of a combined molecular data set of the cpDNA restriction sites and the *rbcL* - *matK* sequences (Xiang, unpubl.) also recognizes *C. sessilis* as a distinct lineage sister to a clade containing *C. mas*, *C. officinalis*, and *C. chinensis* with *C. mas* and *C. officinalis* as sister species. In addition, a cladistic analysis of *Cornus* using morphological data by Murrell (1993) suggested relationships within the cornelian cherries identical to those proposed by Eyde (1988). A high number of mutations were detected between *C. sessilis* and other cornelian cherries. For example, 11 restriction site mutations between *C. sessilis* and *C. mas* - *C. officinalis*, and a total of 22 mutations (including restriction site mutations and all base substitutions in *rbcL* and *matK*) between *C. sessilis* and *C. mas* - *C. officinalis* - *C. chinensis* were found (Xiang et al. in press; Xiang unpubl.), suggesting an early divergence of the species in the cornelian cherry group. A different chromosome number in *Cornus sessilis* ($2n=20$ rather than $2n=18$) and the morphological divergence of the species also support a long history of isolation of *C. sessilis* from other cornelian cherries.

The cornelian cherries have long been known to have a chromosome number of $2n=18$, which was reported for *Cornus mas* and *Cornus officinalis* (Dermen 1932; also see Ferguson 1966b). The chromosome numbers of the other three species in this group have remained unknown. In *Cornus*, a

chromosome number of $2n=20$ has also been documented in the two alternate-leaved, blue-fruited dogwoods, *C. controversa* Hemsley and *C. alternifolia* L. f.. In addition, $2n=22$ has been reported for the big-bracted dogwoods, the dwarf dogwoods, and the opposite-leaved, blue-fruited dogwoods (Bain & Denford 1979; Dermen 1932). The close relatives of *Cornus*, such as *Alangium*, *Mastixia*, and *Nyssa* have also been reported to have a basic chromosome number of $x=11$ (Goldblatt 1978). Therefore, $2n=22$ might be plesiomorphic in *Cornus*, and $2n=20$ and 18 both represent derived states as proposed by Eyde (1988). The molecular phylogeny of *Cornus* (Xiang et al. in press; Xiang unpubl.) is consistent with this hypothesis. The finding of $2n=20$ in *C. sessilis* provides new insight regarding the evolutionary trend of chromosome numbers in *Cornus*. Given the cpDNA phylogeny, the chromosome number of $2n=20$ could have evolved twice in the genus, once in the alternate-leaved blue-fruited species and once in the cornelian cherries before the divergence between *C. sessilis* and *C. chinensis* - *C. officinalis* - *C. mas*. The chromosome number of $2n=18$ found in *C. officinalis* and *C. mas* was derived from ancestors having $2n=20$ (see discussion in Xiang et al. in press).

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